Ergonomics Research Techniques

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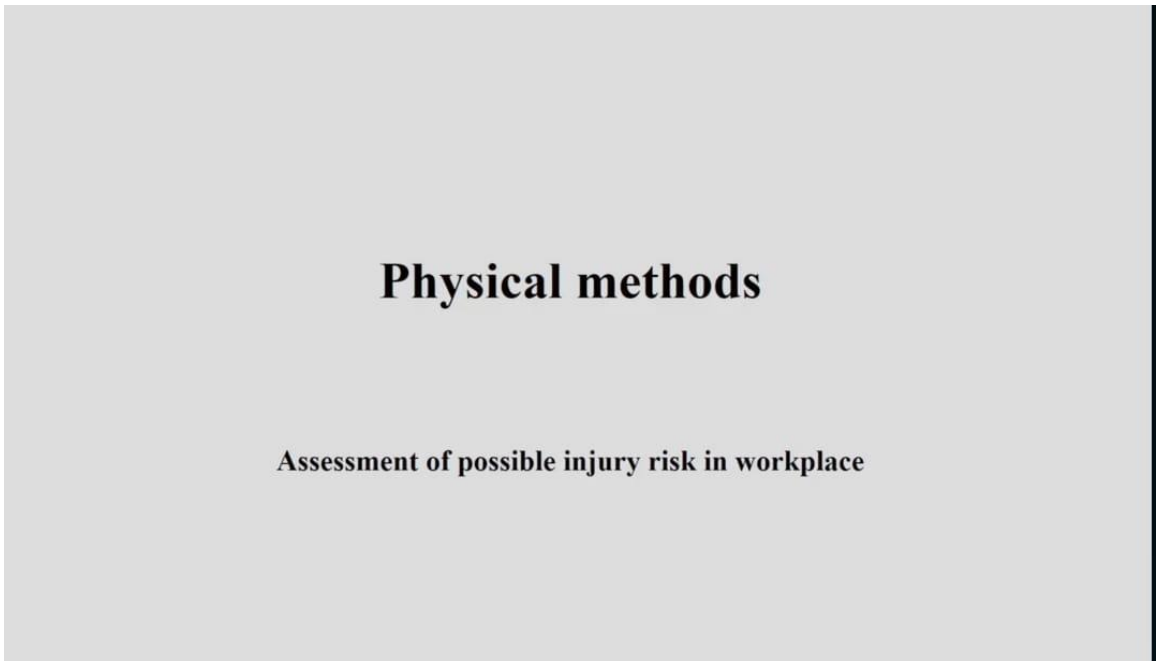
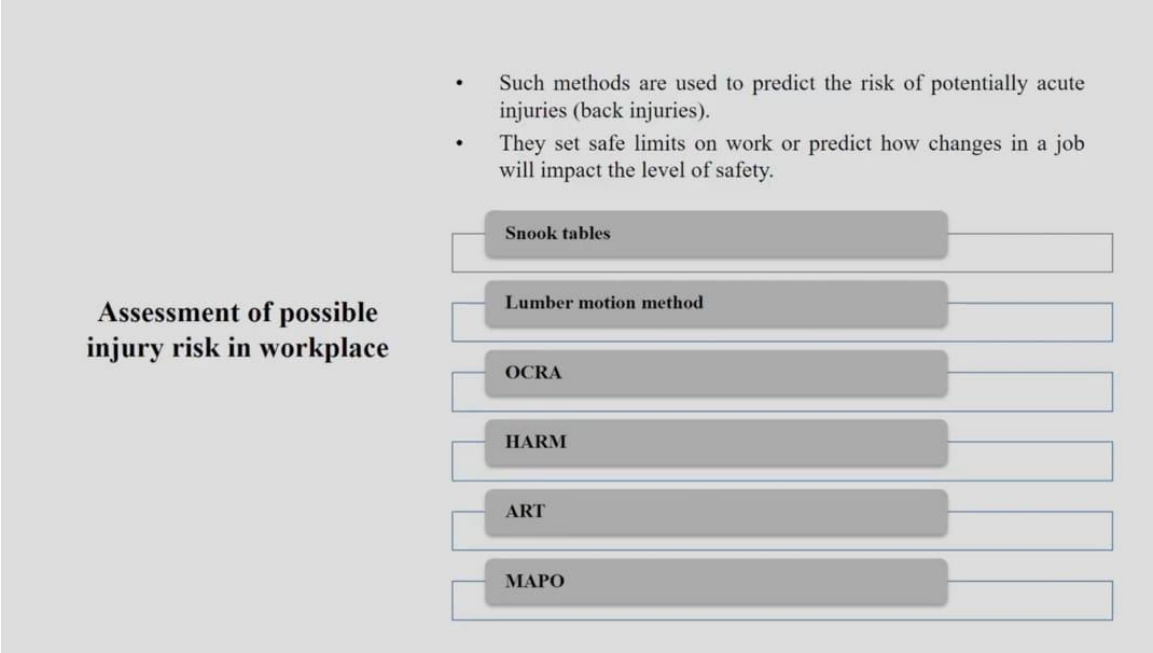
Week – 05

Lecture - 16

Lec 16: Snook's Table



Welcome back. Today, we will take some more tools which is related to physical method and it is going to add these all tools are going to assess the possible injury and risk in the workplace. So, there are there will be sets of tools.

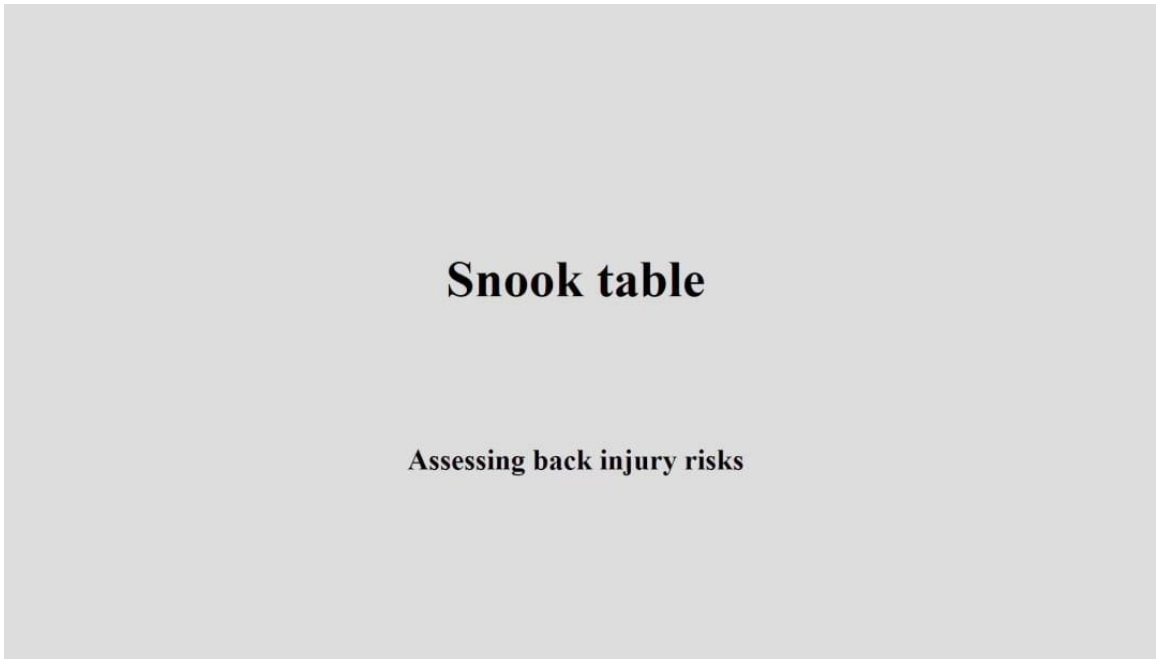


So, mostly we will be talking about Snook's table which is related to manual material handling and going to give you a kind of guideline. If somebody is working at a place, workplace and handling any material, then what is the kind of weight limit they should have. NIOSH lifting equation already we studied there we had lot of calculation, but from this Snook's table, we have some pre-computed table and then we can have some kind of idea or guideline if there is a load handling that what should be the possible load which need to be given to the worker.

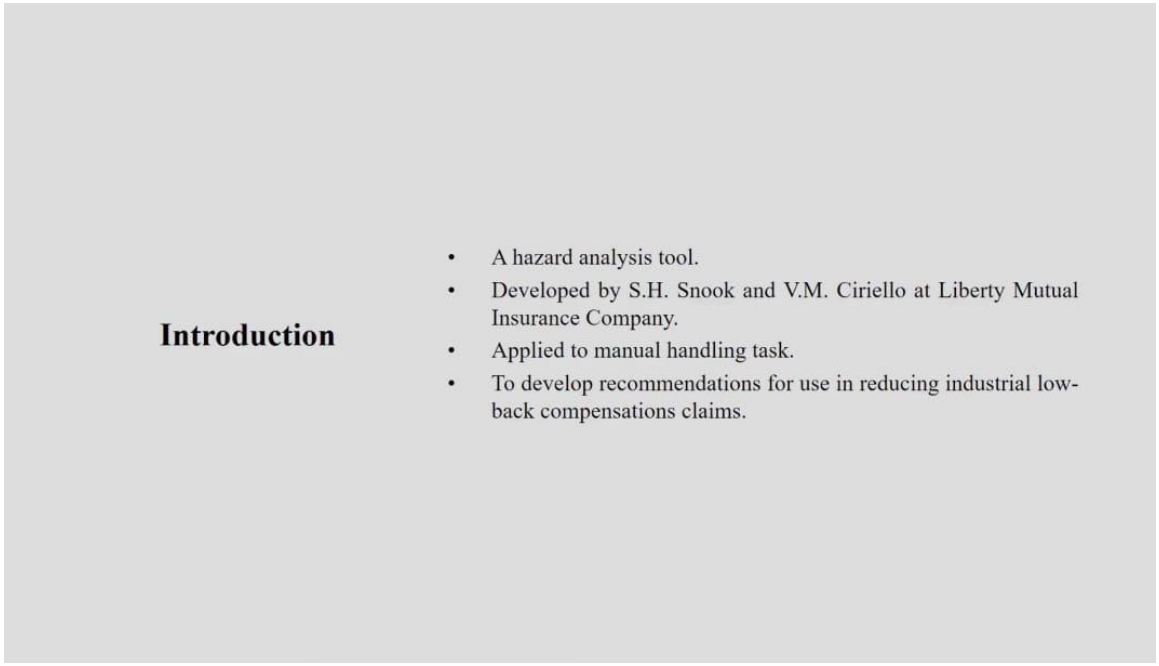
Then we will be talking about Lumber Motion Method. It's an instrument through which if somebody is working with the with your back movement back kinetics, torso kinetics, we will be getting varieties of information. So, how the torso is acting on while doing any in a load lifting or pushing, pulling or movement or any other thing, we will be getting lot of kinetics data. Then all we were going to talk about OCRA, HARM, ART, and MAPO.

All these methods are used to predict. So, these methods these are the tools which are going to use for the prediction. What is the prediction? What we are going to predict over here? We are going to predict the risk of probability of potentially acute injury. Specifically, we will be talking over here the back injuries. So whatever tools we are talking mostly we will be talking about back, but not all are back, few are some others also, but all are predictive method.

So, the set safe limit on work or predict how changes in a job will impact the level of safety, that we are going to do over here.



So, let us start with the very first tool that is the Snook table and it is going to assess the trunk injury or back injury risk. So, if in a workplace there is a risk or there is an hazardous issues, so what are the causal factors or how can we assess those risk in the workplace at the workplace.



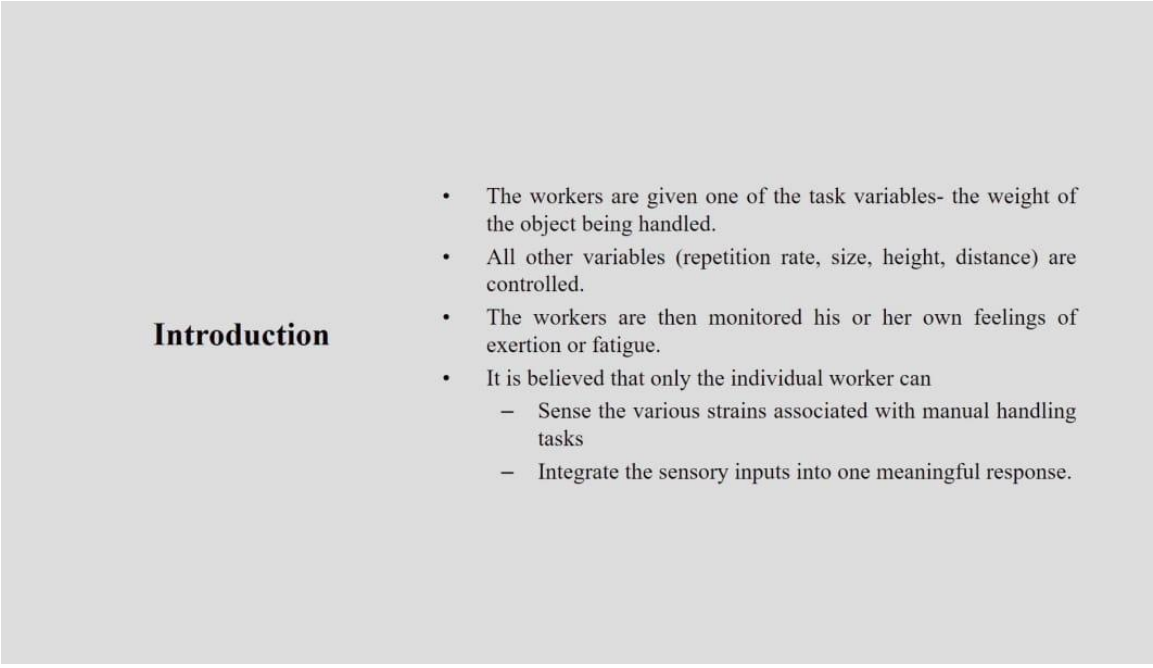
So, it is an hazard analysis tool, it is developed by Professor S.

H. Snook and V.M. Ciriello at Liberty Mutual Insurance Company, because these are, this is very important Liberty Mutual. So long back whenever in the western countries

there is always a policy that health need to be maintained or monitored or need to be taken care by the employer and Liberty Mutual Insurance Company normally is associated with all such activities. So, any health-related issues like specifically back pain, neck pain, any body pain they take care and they also take care of the absenteeism data.

While handling such data they understood definitely the load handling is associated with the trunk injury from that particular observation they develop these particular tool and which is like earlier days when manual handling was majorly dominating task in the industry those days this table was very very popular and they need to follow this rule whatever is given in this table to conduct any kind of manual activity. So, it is applied to manual handling task as I mentioned earlier to develop recommendation for use in reducing industrial low-back compensation claims. So here I mentioned as it is an insurance company so if the employer is not following the rules given by the Liberty Mutual they are not going to give any kind of medical insurance to that for that particular case. So while handling the manual material job like the load handling so they have to follow these rules these guidelines. If still there is a no health issues or health problem specifically back problem then Liberty Mutual is responsible to go for that compensation.

So how you can reduce the back-related injuries and any medical compensation in any organization to do that this particular tool was developed.

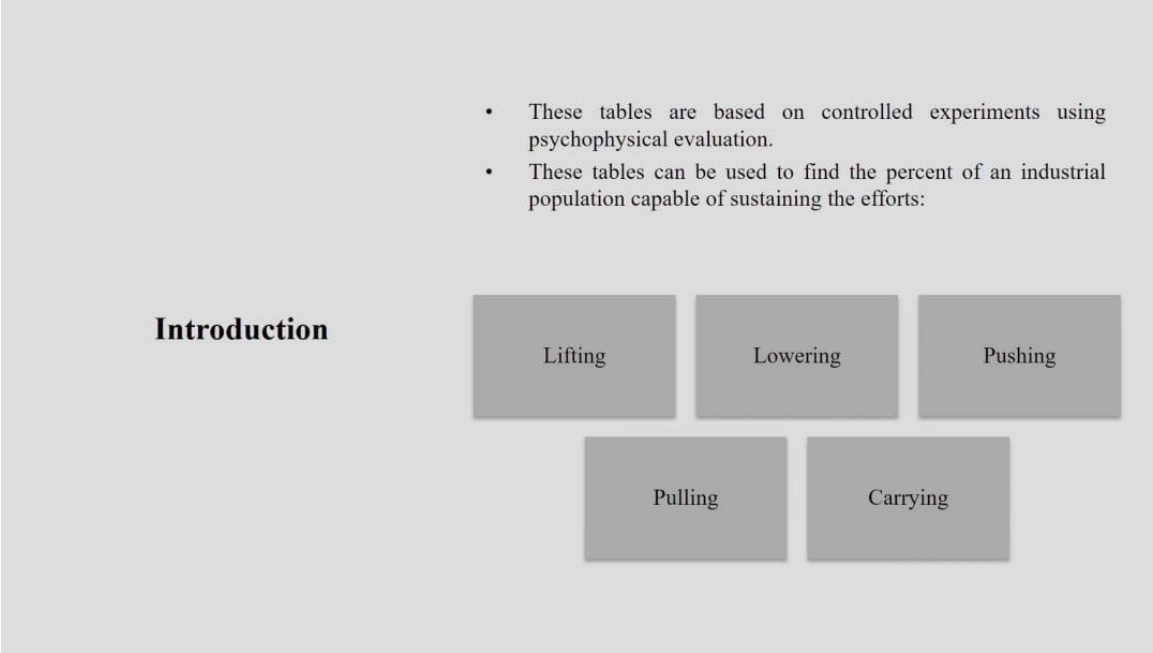


So, the workers are given one of the task variable the weight of the object being handled. So, all other variables like repetition rate, size, height, distance are all controlled. Only

the weight of the product or weight of that object is variable in nature. The workers are then monitored his or her own feelings of exertion of fatigue.

So, while developing this particular tool they have gone through this particular process. So, repetition rate, size, height, distance these were control only load amount was under like you know maybe 10 kg, 14 kg, 15 kg. So, load amount was in variable in nature and while handling such load the workers were asked that or workers were asked to monitor their feeling of exertion, feeling of exertion of fatigue. From there they try to understand what is the kind of severity of this particular job. It is believed that the only the individual workers can sense the various strains associated with the manual task of course.

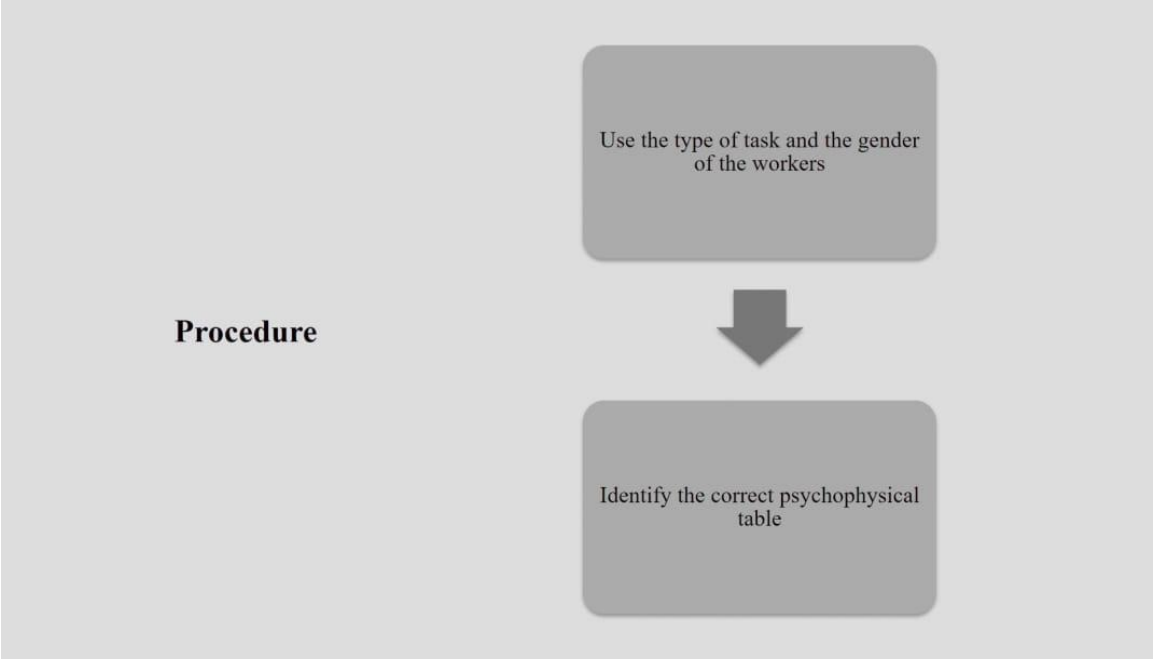
So the understanding of load handling only can be done by that particular operator. You from the outside you really cannot understand what is the kind of strain is getting generated. So, integrate the sensory inputs into one meaningful responses that was also part of the development process. So, these tables it is a Snooks table, it is a sets of tables.



So, these tables are based on controlled experiment using psychophysical evaluation. So they are asking about the load handling, so varieties of load along with getting all the responses, physical and perception. So those responses that is why it is psychophysical evaluation. So, understanding, are you exerted? If you are exerted at what level? Are you feeling this is a strainers job? If strainers at what level? So, these varieties of questions where they are definitely not exactly what I quoted now, but these are the types of questions where they are while conducting this type, this particular experiment. And it is a long experiment, this particular all these tables what you will see in my next slides

took lot of time to get this value and to develop this particular set. So, these tables can be used to find the percent of an industrial population capable of sustaining this particular effort either for lifting or lowering or pushing or pulling or carrying.

So, for each component, these five components, you will have separate table. So slowly we will take one by one.



So, what is the procedure? First, use the type of task, you have to choose which task you are going to do and the gender of the workers. Here it is very important. For female, you have separate data set, for male you have separate data set.

So, first, you need to understand what task you are going to analyze and which gender is going to perform that task. Then identify the correct psychophysical table. So, the correct which one, which table is suitable to you, you select that and then you use that table to get the data.

Procedure

- For lifting and lowering tasks:
  - Use the height of task (floor level to knuckle height) to identify the correct set of columns (right, middle or left) in the table
  - Use the width of object to identify the correct set of rows (upper, middle or lower) in the table
  - At the intersection of the correct sets of columns and rows, use the vertical distance of lift (or lower) to identify the correct 5×8 matrix (upper, middle or lower).
  - Use the repetition rate (e.g., one lift every 2 min.) and the percent of population to identify the correct value in the 5×8 matrix
- 3 tables for maximum acceptable weight of lift for males according to the width of the object
  - 75 cm
  - 49 cm
  - 34 cm

So, for lifting and lowering task, use the height of the task, it is important. So for lifting and lowering task, use the height of the task that is from the floor level to knuckle height to identify the correct set of columns, right column, middle column or left column in that particular table.

So, once we go to the table, we will understand this. Use the width object to identify the correct set of row that is the upper, middle or lower in the table. At the intersection of the correct set of column and rows, use the vertical distance of lift that is either lift or lower to identify the correct 5 by 8 matrix that is the upper middle or lower. Once we go to the table, we will understand more in detail. So, use the repetition rate that is one lift every 20 minute or 2 minutes or one lift for 1 minute.

So, whatever the repetition rate and the percentage of population to identify the correct value from the 5 into 8 matrix, 5 by 8 matrix. So, this is how we are going to get the data. Three tables for maximum acceptable weight of lift for males according to the width of the object, it is present either 75-centimeter, 49-centimeter or 34-centimeter.

Width of Box* (cm)	Vertical Distance of Lift (cm)	Percent of Industrial Population	Floor Level to Knuckle Height — One Lift Every: 5 sec	9 sec	14 sec	1 min	2 min	5 min	30 min	8 hr	Knuckle Height to Shoulder Height — One Lift Every: 5 sec	9 sec	14 sec	1 min	2 min	5 min	30 min	8 hr	Shoulder Height to Arm Reach — One Lift Every: 5 sec	9 sec	14 sec	1 min	2 min	5 min	30 min	8 hr
34	76	90				15	17	19	19	23	8	11	13	15	15	16	18	19	8	10	12	14	14	15	16	18
		75	12	14	17	22	25	28	28	33	11	15	17	20	20	21	23	25	10	14	16	18	19	19	22	24
		50	16	19	22	30	34	37	38	44	14	19	21	25	25	26	29	32	13	17	20	23	24	25	27	30
		25	20	24	28	37	42	47	47	55	17	23	26	30	31	32	36	39	16	21	24	28	29	30	33	36
		10	24	29	33	44	50	54	56	65	20	26	30	35	36	37	41	45	18	24	28	33	33	34	38	42
	51	90	9	10	12	16	18	20	20	24	9	12	14	17	17	18	20	22	8	11	13	16	16	17	18	20
		75	12	15	18	23	26	28	29	34	12	16	18	22	23	23	26	29	11	14	17	21	21	22	24	26
		50	17	20	24	31	35	38	39	46	15	20	23	28	29	30	33	36	14	18	21	26	27	28	31	34
		25	21	25	30	39	44	48	49	57	18	24	27	34	35	36	40	44	17	22	25	32	32	33	37	41
		10	25	30	35	46	52	57	58	68	21	28	32	40	40	42	46	51	19	26	29	37	37	39	43	47
	25	90	10	12	14	18	20	22	23	27	11	14	16	20	20	21	23	26	10	13	15	19	19	19	22	24
		75	15	18	21	26	30	32	33	38	14	18	21	26	27	28	31	34	13	17	20	24	25	26	29	31
		50	20	24	28	35	40	43	44	52	18	23	27	33	34	35	39	43	16	22	25	31	31	33	36	40
		25	26	30	35	44	50	54	55	65	21	28	32	40	41	42	47	52	20	26	30	37	38	39	44	46
		10	29	35	41	52	59	64	66	76	25	33	37	47	47	49	55	60	23	30	35	43	44	45	51	55

Maximum acceptable weight of lift for males (kg)

•What is the maximum acceptable weight for 90% of males lifting a 34-cm-width box with handles for a distance of 76 cm from the floor once every minute?

Ans:

- Width of box= 34 cm
- Vertical distance of lift= 76 cm
- Percent of industrial population= 90%
- One lift every= 1 min

So, the maximum acceptable weight= 15 Kg

Now let us understand this particular table. So, what we supposed to do? First, we need to understand what is the width of this particular table.

So first is this one that is floor-to-knuckle height. So, floor to knuckle height you can see this is the column where you have set of data, this is also one set of data, here also it is one set of data. Now suppose we are talking about, so you have some more elongated table so that you can do. I have taken the cropped portion only for a 34-centimeter width. So, if it is 34-centimeter width, let us understand what is the vertical distance is happening.

Is it 76, 51, or 25? So, any one of it. Now among that, suppose for this particular example I am saying that this is 76. Now let us understand that what is the percent of industrial population you are expecting that the work, that that particular population is going to work for this particular work, So, suppose you have 100 people and you are expecting 90 people will be involved for this lifting task. You may say also you have 100 people and only 75 people are going to do this particular job, then this particular figure need to be chosen. Now let us understand level, you know floor to knuckle height and then one lift for how many? So, repetition.

So, this is for within 5 seconds, 9 seconds or 14 seconds or 1 minute, 2 minutes, 30 minutes, 5 minutes or sorry 30 minutes or 8 hours, within 1, 8 hours. So that you need to check. So, once you see that, so this is the column for your second, this is for your minute and this is for your hour. So, floor level to knuckle height, knuckle height to shoulder height where your lifting is happening and shoulder height to arm reach. So which section you are working? Suppose you are working only for this particular section and

lift, one lift for every 1 second, sorry 1 minute, then you are expecting 90 percent people is going to work for this particular work.

Vertical distance is 76 and your width of the box is 74, then weight limit is 15. So you can see the calculation says 15. Now you can try for some other value. Suppose this is 34 because I have the table right now over here this and the distance is 25 and you are expecting only 25 percent people are going to do this job and this is the area where you know your workers are working and the lift, one lift per is for 9 second. So, you are coming here, then your weight limit is 28 kg.

So, and here this particular table is for male, you have similar table for female, you have similar table for other width of the boxes. So that you can get from original paper of Snook's table. I have taken this one just as an example. I hope it is clear how to read this table. So, it is very similar table as we did in other cases JSI or RULA or REBA.

So here only thing is number of variables are more. So first you have to fixed one, then next, then next and then next. So, there are so many variables. So, accordingly you have to get the value. So why we use this? So, before you set your industrial activity, you know what is the requirement of this particular job and accordingly you can say, so if this is going to be done by this many people and this is the kind of shifting is going to happen, then I should keep my load of this much.

If I need to change the load or if I need to change the or increase the load amount of that particular box, then maybe I need to redesign my workstation so that it is comfortable or it is going to do a best job without hampering any activity. So maybe some problem can happen over this particular region whereas if you do the changes in the workplace layout or workstation height or workstation width, then maybe the same thing is going to shift in this particular region or maybe to this particular region, then data will also change, amount of load handling also will change. So, for same percentage of population, same vertical height, same width of the box, also the total weight will change if these factors are changing or any one of the factor is changing,

Procedure

- For pushing and pulling tasks:
  - Determine the initial force and the sustained force separately.
  - Use the horizontal distance of movement to identify the correct set of columns in the table.
  - Use the height of the hands above the floor to identify the correct set of rows in the table.
  - At the intersection of the correct sets of columns and rows, use the repetition rate and the percent of population to identify the correct value.

So what is the procedure that we are following? So, this we did for the load lifting and load lowering. This is an example for male population. Similar table is available for female and for other width of the boxes.

Now let us do for pushing and pulling. How do we start? So, determine the initial force and sustained force separately. Use the horizontal distance of movement to identify the correct set of columns in the table. Use the height of the hands above the floor to identify the correct set of rows of the table.

Height from Floor to Hands (cm)	Percent of Industrial Population	2.1-m Push						7.6-m Push						15.2-m Push						30.5-m Push						45.7-m Push						61.0-m Push					
		One Push Every						One Push Every						One Push Every						One Push Every						One Push Every						One Push Every					
		6 sec	12 sec	1 min	2 min	5 min	30 min	8 hr	15 sec	22 sec	1 min	2 min	5 min	30 min	8 hr	9 sec	14 sec	1 min	2 min	5 min	30 min	8 hr	1 min	2 min	5 min	30 min	8 hr	1 min	2 min	5 min	30 min	8 hr	2 min	5 min	30 min	8 hr
Initial Force (the force required to get an object in motion)																																					
135	90	14	15	17	18	20	21	22	15	16	16	16	18	19	20	12	14	14	14	16	16	17	12	13	14	15	17	12	13	14	15	17	12	13	14	15
	75	17	18	21	22	24	25	27	18	19	19	20	22	23	24	15	17	17	17	19	20	21	15	16	17	19	21	15	16	17	19	21	14	15	17	19
	50	20	22	25	26	29	30	32	21	23	23	24	26	27	29	18	20	20	20	23	23	25	18	19	21	22	25	18	19	21	22	25	17	18	20	22
	25	24	25	29	30	33	35	37	25	26	27	28	31	32	34	20	23	23	24	27	27	29	20	22	24	26	29	20	22	24	26	29	20	21	23	26
	10	26	28	33	34	38	39	41	28	30	30	31	34	36	38	23	26	26	26	31	31	32	23	25	27	29	33	23	25	27	29	33	22	24	26	29
89	90	14	15	17	18	20	21	22	14	15	16	17	19	19	21	11	13	14	14	16	16	17	12	14	15	16	18	12	14	15	16	18	12	13	14	16
	75																			17	19	21	15	16	18	19	21	15	16	18	19	21	15	16	17	19
	50	20	22	25	26	29	30	32	20	21	23	24	27	28	30	16	19	20	21	23	24	25	18	20	21	23	26	18	20	21	23	26	18	19	20	23
	25	24	25	29	30	33	35	37	23	25	27	28	31	33	34	19	22	23	24	27	28	29	21	23	24	26	30	21	23	24	26	30	20	22	24	27
	10	26	28	33	34	38	39	41	26	28	31	32	35	37	39	22	24	26	27	30	31	33	24	26	28	30	33	24	26	28	30	33	23	25	26	30
57	90	11	12	14	14	16	17	18	11	12	14	14	16	16	17	9	11	12	12	13	14	15	11	12	12	13	15	11	12	12	13	15	10	11	12	13
	75	14	15	17	17	19	20	21	14	15	17	17	19	20	21	11	13	14	15	16	17	18	13	14	15	16	18	13	14	15	16	18	12	13	14	16
	50	16	17	20	21	23	24	25	16	18	20	21	23	24	25	14	15	17	18	19	20	21	15	17	18	19	22	15	17	18	19	22	15	16	17	19
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	10	21	23	26	27	30	31	33	22	23	26	27	30	31	33	18	20	22	23	25	26	28	20	22	23	25	28	20	22	23	25	28	19	21	23	25

Maximum acceptable initial force for pushing for males (kg)

•What is the maximum acceptable initial force for 75% of females pushing a cart with 89 cm height handle for a distance 15.2 m once every 5 minutes?

Ans:

- Height from floor to hand= 89 cm
- Distance cover to push= 15.2 m
- Percent of industrial population= 75%
- One push every= 5 min

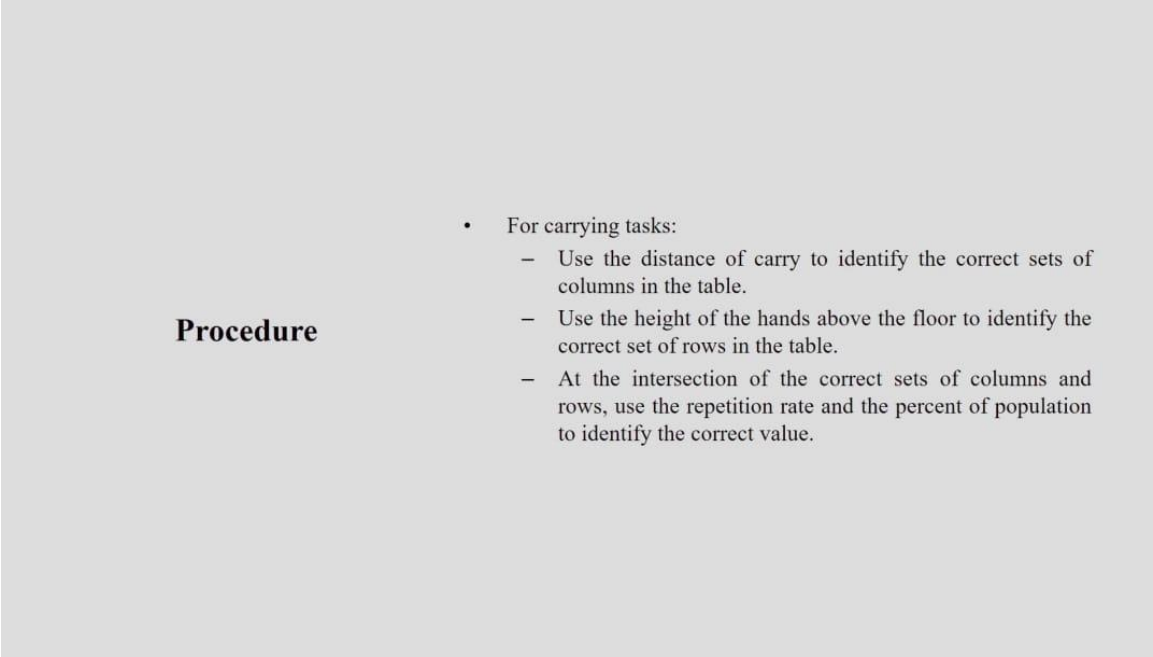
So, the maximum acceptable initial force= 19 Kg

So let us take the example. So here you can see height from floor to hand. So, either this centimeter or this or this, anyone, any anything between this. So, you may ask suppose your for your case the height is 90 centimeters, then what you will do? You either go with 89 that is very near value, but if you have an understanding, if I if you want to cover maximum possible risk, then you can take this as well. Now normally what we do? We try to take the column like the row which is nearest. So, if you talk about 90, this is nearest to this particular.

But if you see I have a value of 120, then where do you go? Are you going to come to 89 or 135? From my experience, I will suggest you take the column of 135. Why? Because if not 135 is like is going to give you good data, correct data, still there is a chance that you are, covering the maximum possible risk or you are considering maximum possible risk. So, if you do for 135, then definitely there will be no chance of injury. But if you take 89, maybe there is some percentage of chances where injury can happen.

So that way you should decide. Now here you see that for this particular example, it is taken as 75, and as it is push, so 15.2-meter push and one push in every 5 minutes. So, the value becomes 19, so 19 kg. Again, the data is for male population.

Again, the data is for male population. So, this is how the example look like. This is for push, push male data.



Now let similar data for pulling also, similar table for pulling is also available. You can get the data from original paper. If you do not get access, let us know in the discussion,

you know, chat box or something, then maybe we can also provide you the actual, the original full table.

Now for carrying, what is the procedure? Use the distance of carry to identify the correct set of columns in table. Use the height of the hands above the floor to identify the correct set of rows in the table. At the intersection of the correct sets of columns and rows, use the repetition rate and the percentage, percent of population to identify the correct value. Very similar as we did for lifting, lowering, pulling, and pushing.

So let us see the carrying. So here I have not given example. You can take the particular screenshot of carrying table. Maybe you can try for that particular table. So, I have not given example for carrying here. So it is, I hope it is clear that how to read the table.

So full sets are available with the original publication. If you do not find it, let us know, we will going, we are going to put it in the chat box.

Advantages

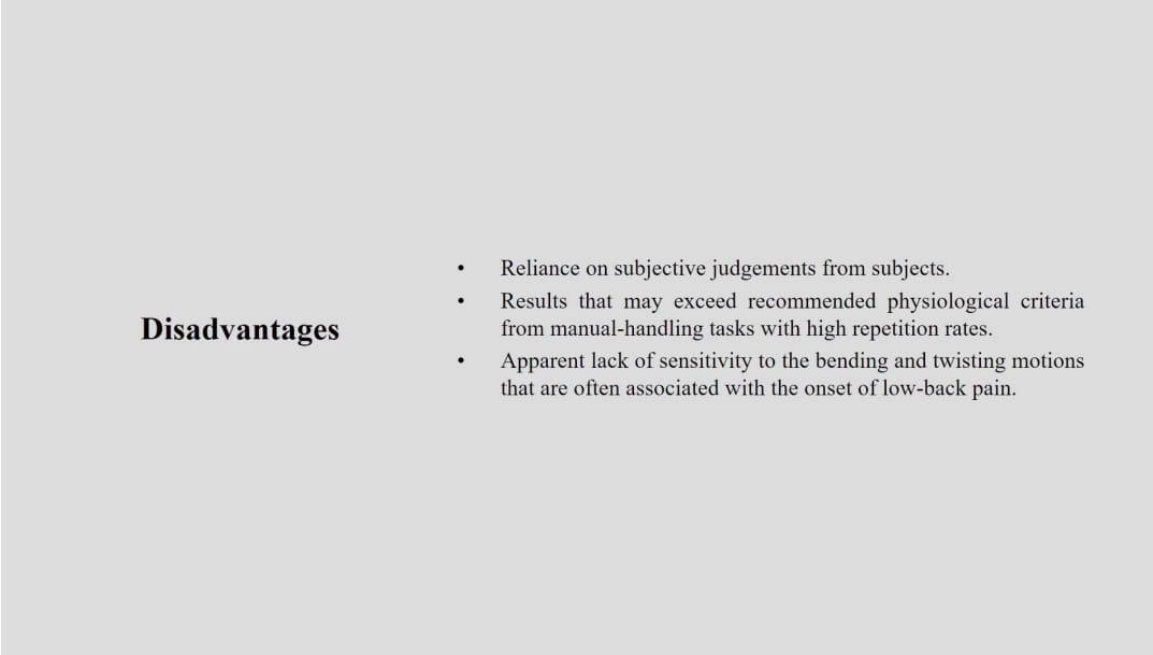
- Capability to realistically simulate industrial work.
- Capability to study very intermittent manual-handling tasks and very fast repetitive tasks.
- Results that are consistent with the industrial engineering.
- Results that are very reproducible.
- Capability to measure subjective variables (pain, fatigue, discomfort)- variables that can not be measured objectively.
- Industrial application that is less costly and time consuming than most other methods.
- Capability of exposing subjects to hazardous tasks without excessive risk.

Now what are the advantages of this particular table? So, capability to realistically simulate the industrial work. So based on the number of person is going to do the job, what is the workstation design, what is the type of material they are going to handle, based on all these data you can simulate the actual work activity. So, capability of, to study very intermittent manual handling task and very fast repetitive task that is also possible because you have seen that in 5 seconds how many repetition.

So that minute data also you can see the, you can see the simulation. Results that are consistent with the industrial engineering because most of the cases industrial engineers

before setting up the actual setup they use these Snooks table to get the result or set the norms for that particular activity. Capability to measure subjective variables like pain, subjective discomfort and all those things, variables that cannot be measured objectively. Suppose I am talking about pain, you cannot understand or you cannot measure that pain sensation right, but you can get the subjective value. So, this Snooks table can have some kind of interpretation on these aspects.

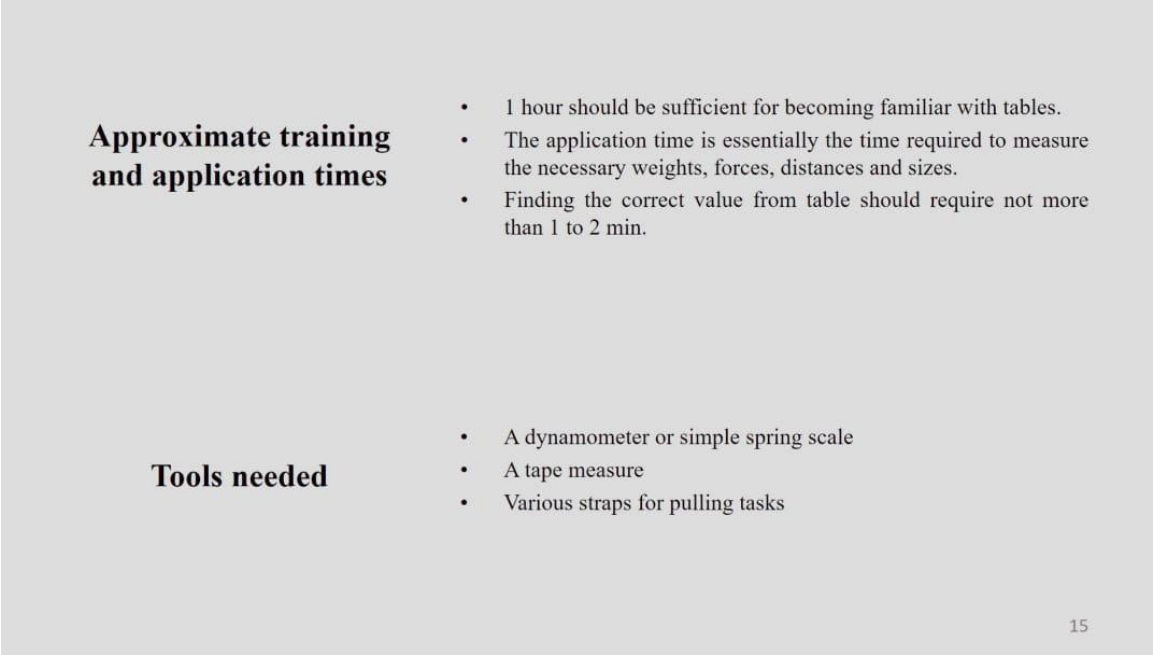
Industrial application that is less costly and time-consuming than most other, less time consuming than any other such method. Capability of exposing subjects to hazard a task without excessive risk. Without excessive risk you can get the work done, simulated data you can collect it. So, this is very very useful tool and if you look at various industry Snooks table are always in use wherever the manual handling is present. So, among the industrial engineers, this tool is very popular and of course, any ergonomist can use this tool to decide that where the intervention or design changes can be done.



But again there are some disadvantages. Reliance on subjective judgments from the subjects, results that may exceed recommended physiological criteria from manual handling task with high repetition rate you cannot do, and apparent lack of sensitivity to the bending, twisting because we are not considering the posture. We are only talking about repetition we are talking about the position and the width and the movement. So this much only we are considering. We are not considering any kind of posture over here specifically trunk posture or neck posture no posture is being considered. So that it is not sensitive to the bending or twisting motion that are often associated with the onset of low back pain.

So, although we are talking about the risk or injury identification for the low back pain using this particular table, but it is not considering the trunk or trunk bending. So, these are some kind of disadvantages for this tool. So, if you find any difficulties maybe you have to take some more detailed method or some other method if you are expecting the bending and twisting is causal factor for this particular low back pain fine. So, this is all about Snook's table.

Now we will go to next next part of another instrument. It is this particular Snook table is a pen-paper method.



So here also these things are available like as an information it is maybe you have tape measure various straps for pulling task and it is one hour should be sufficient for becoming familiar with this particular table and it does not take much time to get the result. So, once you understand that particular table in detail you can do the analysis very quickly you can collect the data very quickly. Thank you.